A Systematic Study of the External Male Genitalia of the Genus *Septis* (Lepidoptera, Phalaenidae)

by

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A Thesis

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In this study of the external male genitalia of the members of the genus Septis, the specimens used belong to the Canadian National Collection of insects. Of the fifty-six species and "infraspecies" of Septis now attributed to North America, the male genitalia of forty-four have been described. Twenty-six of these have been figured.

Descriptions of and a key to the genitalia of the species and "infraspecies" studied are presented. With the exception of Septis arctica Frr. and Septis castanea Grt., all of the species studied could be differentiated on the basis of the structure of the male genitalia.

A revision of the genus Septis would appear to be very desirable. On the basis of the structure of the male genitalia, the species fall into rather well-defined groups which would appear to be equivalent to the present accepted genera of the Phalaenines. Moreover, in the genus, a number of races differ considerably from the typical form in the structure of their male genitalia. With further study these presently recognized races may be found deserving of specific rank.

CONTENTS

I. ACKNOWLEDGEMENTS

To Dr. E. Melville Du Porte, under whose direction the writer has prosecuted his graduate work, I should like to express my appreciation for constructive criticism of the following work.

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I should also like to express my thanks to my brother John Hardwick for the lettering that he so kindly did for the accompanying figures and to my wife Verna Hardwick for the typing of this thesis.

II. STATEMENT OF THE PROBLEM

The purpose of the following study is twofold. It seeks primarily to present a workable key to the species of the genus Septis for the use of students of the Phalaenidae. The lepidopterist is dependent, to a considerable extent, upon a large reference collection in the determination of material. Such collections, however, are not always accessible to the worker, especially the amateur. In the absence of such a collection the student is forced to rely on keys. In the past, subfamily and generic keys have been based largely either on venation or on such characters as spining of the tibiae, hairiness of the eyes, structure and vestiture of the palpi,etc. Keys based largely on venational characters such as those found in Forbes's Lepidoptera of New York and Neighbouring States, are rendered useless to a large degree by the scaling of the wings, unless the specimen be destroyed to make a suitable venational mount.

The nature of various structures of the head and legs has also been widely used in subfamily and generic keys. The same criticism may be applied to these keys, however, as to those based on venation. The nature of diagnostic structures of the head and legs is often obscured by the heavy scaling, making the use of these keys difficult.

Specific keys, such as those found in Hampson's work, Catalogue of Lepidopterous Phalaenae in the Collection of the British Museum, have been based largely on the macu-

lation and coloration of the vestiture of the wings and body. This is unfortunate. Coloration and maculation are subject to great individual variability. Keys based on the structure of the external male genitalia, while offering a more certain means of identification, are not, by any means, without fault. Time and effort must go into the preparation of genitalic slides: the organs cannot be satisfactorily examined in <u>situ</u>, even when the terminal portion of the abdomen has been relaxed with a fine jet of steam. While the apical portions of the claspers may be examined by this method, nothing of the structure of the juxta, vesica, or other inner portions of the external genitalia can be detected.

A second shortcoming associated with the determination of Lepidoptera by means of genitalia, is the reduction in the value of the specimen resulting from the necessity of removing the whole abdomen, or at least a considerable portion thereof, to prepare a suitable genitalic mount.

To the present time, the study of genitalia has found its greatest usefulness in the separation of closely related species which are difficult to differentiate solely on the basis of maculation and colouring. The male genitalia have been most extensively used in this connection, but the female organs might be equally useful if more intensively studied.

Outside the realm of determinations the external genitalia are very useful in determining natural relationships of species within a group. In his revision of the

Agrotid moths, McDunnough (1928), although making judicious use of other characters, has to a large degree based his conclusions as to relationship upon the male genitalia:

> "As frequently stated in previous papers, the writer is a firm believer in the value of the characters found in the male genitalia when used with discretion, both as a means of specific and of generic separation. The writer is, therefore, inclined, in reviewing a list of such characters as may be so used, to put considerable stress (possibly an undue amount) on genitalic similarity or dissimilarity."

I think time has shown the validity of McDunnough's classification of the Phalaenines. In the following study, therefore, not only will the means of specific identification be presented, but relationship as indicated by the extemal male genitalia (for what it may be worth when not combined with the study of other characters) will be suggested.

III. HISTORICAL REVIEW

J.B. Smith, in his many papers published under the general title of Contributions Toward a Monograph of the Noctuidae of Temperate North America, made but brief reference to the male genitalia of the species of the various groups with which he was working at the time.

In his 1890 revision of those species of the genus Hadena "referable to Xylophasia and Luperina" he characterized the male genitalia of that general group of Amphipyrines to which the genus Septis belongs:

> "The genital structure of the male affords a convenient basis for division, those species treated here all agreeing in having the harpes (claspers)

> abruptly modified into a trigonate tip (cucullus), set almost at right angles to the harpe, and inside this bearing a single corneous clasper (harpe) of variable length, supplemented in some cases by small secondary claspers (ampullae) attached to harpes nearer to the base."

In his discussion of the various species of Xylophasia, Smith contributes short and inadequate notes as to the general structure of the male genitalia, and he makes no use of their characters in his keys. His drawings, difficult to interpret because of the confusion of lines, designate but a portion of one clasper of each of some two dozen species of Septis. As McDunnough (1928) points out, Smith's technique renders his work on the genitalia of no great significance because "his rather crude figures give no idea of the whole organ and the interrelationships of the various parts". According to McDunnough it was Smith's custom to break one clasper in the dry condition and figure as much or as little of it as happened to come away. This view is certainly substantiated by the varying amounts of the clasper shown in Smith's figures.

Since Smith's revision of 1890, no further detailed and comparative study has been made of the male genitalia of Septis. Comparatively recent descriptions of species and races, those of Barnes and McDunnough (1913) and of McDunnough (1940), include short notes on the structure of male genitalia. These are in the form of a comparison, pointing out the similarity and contrast between the genitalia of the new species or race and those of a closely

related species.

IV. MORPHOLOGY OF THE EXTERNAL MALE GENITALIA

The external male genitalia of Septis present posteriorly a dorso-ventrally elongated, more or less irregular, sclerotic ring. The dorsal portion of this ring is the tegumen (Plate I, Tg) and the ventral portion is the vinculum (Vn). At the apex of the tegumen arises a ventrally arched, finger-like process, the uncus (Un). Articulated to the vinculum laterally, are the large, elongate, genital appendages of the male, the claspers (Clp). The bases of the claspers project across the posterior edges of the vinculum and articulate with a sclerotized plate that occurs between their mesal borders. This plate is known as the juxta (Jx). Projecting postero-dorsally through the ring formed by the tegumen and the vinculum and supported ventrally by the juxta, is the tubular penis (Pns). Ventral to the arch of the tegumen and dorsal to the penis, lies the anus. The terminal portion of the latter, unlike that of certain other Lepidoptera, is entirely membranous.

A. THE UNCUS

The uncus, so named by Gosse in 1885, together with the gnathos, a hook-like, heavily sclerotized structure, occurring in some Lepidoptera beneath the anus, is derived from the tenth somite. Because of the retraction

of the tenth segment, the uncus has become associated with the tegumen. (Eyer, 1924) The gnathos is wanting among the members of the genus Septis. The uncus is well developed, and while always consisting of a single lobe, it may assume a variety of forms.

The uncus arises from a triangular or rounded lobe that rests upon the apex of the teguminal arch. To this structure I have given the name pedestal (Pd). The pedestal of some Septis is greatly elongated dorso-ventrally.

B. THE TEGUMEN

The tegumen was first named the "upper organ" by Scudder and Burgess in 1870 but the present accepted term was later substituted by Buchanan-White in 1876. (Eyer,1924) As first used by Buchanan-White the term tegumen included the dorsal and ventral portions of the sclerotic ring, but the ventral portion was later termed the vinculum by Pierce (1909) so that the term tegumen is now used to designate only the dorsal portion of the ring.

The tegumen seems to be generally accepted as representing the tergum of the ninth segment, the tenth segment being membranous except for the uncus and gnathos where the latter is present. Peytoureau (cited by Eyer, 1924) proposed that the tegumen represents the fused ninth and tenth terga, and Busck and Heinrich (1921) maintained that the tegumen along with the uncus and the gnathos represents the tenth tergum, the ninth tergum being membranous.

Laterally, from each arm of the tegumen, arises a large hairy lobe, designated the peniculus (Pn) by Pierce (1909). The peniculus varies much in size and shape among members of the genus Septis. Immediately ventral to the peniculus the arms of the tegumen articulate with the arms of the vinculum.

C. THE VINCULUM

The U or V-shaped vinculum is usually considered to be the sternum of the ninth segment although Peytoureau (cited by Eyer, 1924) thought it to be a sclerotized portion of the membrane between the eighth and ninth sterna. This view of the nature of the vinculum has been proposed more recently by Bierne (1942) and Freeman (1947).

The vinculum is well developed in Septis and while typically U-shaped and rounded, it may be somewhat flattened ventrally. The ventral extremity of the vinculum may be produced into a process termed the saccus by Baker (Eyer, 1924). In Septis the saccus is absent or expressed merely as a slight projection.

D. THE JUXTA

From between the arms of the vinculum, the apex of the penis protrudes posteriorly. It is ensheathed by a membranous, cone-like tube termed the anellus by Pierce (1914). The anellus itself is undecorated with hooks or other processes such as are found in certain other Lepido-

ptera. Ventrally, a portion of the anellus is sclerotized to form a shield-shaped plate, the juxta (Jx), which closely embraces the lower surface of the penis. Its plane is directed obliquely, as is the penis which it flanks. Its dorsolateral angles may be produced to form arms which partially encircle the intromittent organ. The lateral margins of the juxta bear processes which articulate with processes of the mesal margins of the claspers. The juxta varies considerably in size and shape among the members of the genus Septis.

Bierne (1942) and Freeman (1947) maintain that the sternum of the ninth segment is represented by the juxta and not by the vinculum as is commonly supposed. According to this view the vinculum is merely a sclerotization of the intersegmental membrane between the eighth and ninth sterna.

E. THE CLASPERS

The large genital clasping organs of male Lepidoptera which are articulated with the posterior surfaces of the arms of the vinculum, were first named the valvae by Kirby and Spence in 1858. Subsequently they were renamed the clasps by Scudder and Burgess in 1870, and harpogones by Buchanan-White in 1876. (Eyer, 1924)

This renaming of these structures has resulted in a great deal of confusion in the literature pertaining to the external male genitalia. In all his papers on the Noctuids, Smith constantly refers to the clasping organs as harpes. McDunnough, on the other hand, uses the term claspers.

The clasper of McDunnough is the harpe of Smith and the harpe of McDunnough is the clasper of Smith. In this study I have adopted McDunnough's terminology because of the extensive contributions made by him to the knowledge of the male genitalia of the Lepidoptera of North America.

The claspers are usually considered to be derivatives of the styli of the coxopodites of the ninth abdominal segment. Mitchener (1944), however, suggests that they represent the coxopodites themselves rather than their styli.

The claspers in the genus Septis may be divided into three well-defined regions which have been termed by Pierce (1909, 1914) sacculus, costa, and cucullus.

The sacculus is the heavily sclerotized basal portion of the clasper. It appears to be formed of part of the outer (or anterior) wall of the clasper which has been extended ventrally and folded over the inner (or posterior) surface of the clasper. At its dorsal margin this inner fold of the sacculus forms a rounded lobe which has been termed the clavus (Clv) by Pierce (1909). The clavus may have varying degrees of expression in any one species. For example, in some specimens of Septis arctica Frr. (Plate I) it may be expressed merely as a broad dorsal lobe, while in other specimens there is also present a finger-like projection seemingly formed by a curling of the free dorsal margin of the sacculus.

The sacculus is extended distally along the ventral margin of the clasper, and this portion of it is referred to as the sacculus extension (Sc Ex). The ventral margin of

the clasper is sometimes bulged in the region of the sacculus extension, giving the latter a somewhat triangular appearance. Marginal setae are often present along the ventral border of the apical portion of the sacculus extension. The sacculus in the genus never has free arms proceeding from it like those that occur in many Phalaenids. The plane of the sacculus extension slopes down from that of the sacculus proper to that of the costa where it joins the latter at its apex. Along the dorsal or dorso-mesal edge of the sacculus extension where it borders the costa there is a heavily sclerotized rod-like portion, which I have termed the median rod (Md Rd).

The costa occupies the dorsal and the middle portion of the clasper. Its plane is considerably lower than that of the sacculus. It is bordered mesally by the sacculus proper and ventrally by the sacculus extension. Its dorsal border forms the costal margin of the clasper. Distal to the sacculus extension, a narrow apical portion of the costa extends completely across the clasper from ventral to costal margins. The dorso-mesal angle of the costa is connected to the anellus by a narrow, weakly sclerotized band. This is the transtilla.

The costal area bears three constantly occurring processes. In its middle area there is present a small, weakly sclerotized, finger-like process, the ampulla (Am), so named by Pierce (1909). The ampulla arises from near or sometimes from beneath the median rod. It usually pro-

jects toward the costal margin although commonly it is excurved so that its apex is directed toward the ventral margin. In the genus Septis the ampulla is usually long and slender although in some cases it is short and stout or even reduced to a small, nipple-like process. The ampulla is subject to considerable individual variability in the genus and is therefore one of the less reliable taxonomic characters.

Mesal to the ampulla there is present a small,hairy prominence called, by Pierce (1909), the editum. The editum of Septis is a constant structure and without taxonomic significance.

Apically the costa gives origin to a heavily sclerotized rod-like arm that arises from a strong base and projects over the ventral margin of the clasper. In his work with the genus Septis and related genera, Smith (1890) terms structure the clasper, and this terminology has been accepted by Pierce (1909, 1914). I am inclined to accept McDunnough's terminology in the matter of male genitalia, however, and call this structure the harpe (Hp).

The harpe is one of the most trustworthy features of the genitalia. It may be elongate or reduced to a tiny projection. It may be rounded or flattened and it is commonly twisted. Although it is typically unbranched, in one or two species of Septis it is bifurcate.

Bordering the apex of the costa dorso-laterally is the large terminal portion of the clasper, the cucullus (Cc). In the genus the cucullus is always trigonate.

The plane of the cucullus is well raised above that of the costa.

Along the lateral margin of the cucullus is a uniform row of articulated cuticular processes, which have been collectively termed the corona (Cr) by Pierce (1909). The corona is a constant feature of the cucullus of all the species of Septis.

Along the ventral margin of the cucullus there is usually present in the genus an area of varying size and shape which is densely clothed with similar cuticular processes. I call this feature of the cucullus the inferior spine mass (In Sp).

The processes comprising the corona and the inferior spine mass are, according to modern terminology, either setae or spurs. Because these structures have always been referred to as spines by Lepidopterists, however, and because I am uncertain as to whether they are spurs or setae, the older term has been retained here.

To the angle formed between the lateral and ventral margins of the cucullus Pierce (1909) has applied the term anal angle (An An). Similarly the one formed between the lateral and the dorsal margins of the cucullus may be termed the apical angle (Ap An), and the one between the ventral and dorsal margins the basal angle (Bs An).

F. THE PENIS

The penis (Pns) consists of a sclerotized tube,

the aedoeagus (Ad), and a bag-like, membranous portion, the vesica (Vs) which is continuous with the apex of the aedoeagus and which normally lies folded within it. The vesica is everted during copulation.

The aedoeagus is typically long and slender among the members of Septis but in a few cases it is short and stout. In many cases it is decorated by a usually small, scobinated area distally. To this region I have applied the term, apical scobinated area (Ap Sc).

The vesica is usually decorated with one or more processes termed the cornuti (Crs) by Pierce (1909). In the genus these are often borne on sclerotized arms extending onto the vesica from the apical margin of the aedoeagus. The armature of the vesica is one of the most distinctive diagnostic features of the male genitalia.

V. TECHNIQUE

The abdomens of the moths whose genitalia were to be studied were broken off at their juncture with the thorax by a simple process of grasping the abdomens with a pair of forcepts and moving them up or down. The entire abdomen was removed because attempts made to cut that portion of the abdomen containing the genitalia from the rest often result in the shattering of various parts or the severing of the terminal portion of the vinculum.

The severed abdomens were submerged in 5-10%

potassium hydroxide over night to soften the various parts, dissolve the muscle, and bleach some of the more darkly pigmented portions.

By grasping the anterior portion of the softened abdomen with forceps, and pressing gently in the middle region with another instrument, the genitalia were made to protrude from the posterior end of the abdomen. The external genitalia were then easily severed from the rest of the body. This dissection was done in 30% alcohol. Superfluous hair was removed from the apices of the claspers, from the base of the uncus, and from the peniculi by pulling them out with fine forceps or by scraping them off with a flattened dissecting needle.

The penis was removed from between the arms of the vinculum by grasping its anterior basal portion with a pair of forceps and pulling it out of its enclosed sheath. The vesica was then everted by inserting a fine needle into the membranous portion of the aedoeagus where the ductus ejaculatorius enters it sub-basally. By judicious manipulation of the end of the needle thus inserted, the vesica could usually be everted without tearing it.

The genitalia were then removed from 30% to 70% alcohol and left in this medium for a matter of half an hour. The claspers were flattened by extending them and placing a small chip of glass over them while they were dehydrating in the 70% alcohol. This medium was then removed with an eye-dropper and a small quantity of 95% alcohol poured on. The

latter liquid served to harden the claspers in the outspread condition.

The genitalia were cleared in clove oil for about a quarter of an hour, rinsed in xylol, and mounted in a xylol solution of equal parts Canada balsam and clarite. The latter mounting medium is preferred but since supply was running short it was diluted with Canada balsam. The penis was mounted alongside the claspers and their supporting structures.

In drawing, the general outline of the genitalia was obtained with the assistance of a microscope slide projector, and the finer details later inserted by examination of the mounted genitalia with a binocular microscope.

Finished drawings were made on Strathmore board with contour and crow's foot pens. The penis, as figures, is removed from its natural surroundings and placed to the right hand side of the other structures. The juxta, which normally projects obliquely between the bases of the claspers, is figured as if it occupied an entirely vertical position. Moreover, the juxta, as figured, is entirely dissociated from the margins of the claspers with which it normally articulates. This was done to give a clear view of the lateral margins of the juxta which are normally obscured by the overlapping of the articulatory processes of the mesal margins of the claspers. Membranous areas, and structures such as the anus, the anellus, and the transtilla, were not figured because of their lack of taxonomic value.

VI. GLOSSARY OF TERMS APPLIED TO STRUCTURES OF THE MALE GENITALIA

Ad — Aedoeagus. The sclerotic tubular portion of the penis, containing the vesica when the latter is not everted.

Am — Ampulla. A usually slender, finger-like process arising from the costa near its ventro-lateral border.

An An — Anal Angle. That angle of the cucullus formed between the ventral and lateral margins.

Ap An — Apical Angle. That angle of the cucullus formed between the dorsal and the lateral margins.

Ap Sc — Apical Scobinated Area. An area of variable size at the apex of the aedoeagus in which the cuticle is produced into a number of spicules.

Bs An — Basal Angle. That angle of the cucullus formed between the dorsal and the ventral margins.

Cc — Cucullus. The apical portion of the clasper. In the members of Septis it is trigonate and set at an angle to the rest of the clasper.

Clp — Clasper. One of the two large, movable clasping organs of the male. They articulate mesally with the juxta. The claspers are derived from the appendages of the ninth segment.

Clv — Clavus. A broad, variable lobe or thumb-like process developed on the dorso-mesal angle of the sacculus.

Cr — Corona. A regular row of inward-projecting spines borne along the lateral margin of the cucullus. It is always present in the genus.

Crs — Cornutus. A spine or sclerotized comb borne upon the vesica of the penis. Sometimes cornuti arise from sclerotized arms extending onto the vesica from the apex of the aedoeagus.

Cs — Costa. The middle region of the clasper lying between the sacculus and the cucullus. It gives origin to the ampulla and the harpe.

Hp — Harpe. A rod-like arm, originating in members of Septis from the apex of the costa and extending over the ventral margin of the clasper.

In Sp Inferior Spine Mass. A cluster of spines present on the cucullus of most species of the genus. It commonly extends along the ventral margin of the cucullus but it may extend dorsally into the interior of the latter.

Jx Juxta. A median, typically shield-shaped sclerotized plate that articulates laterally with the mesal margins of the claspers. It is closely applied to the ventral surface of the penis.

Md Rd Median Rod. A heavily sclerotized bar extending along the dorso-mesal margin of the sacculus extension, thus separating the latter from the costa.

Pd Pedestal. A mesal, triangular, or rounded process resting upon the dorsal surface of the tegumen and acting as a base for the uncus.

Pn Peniculus. One of two large, hairy lobes arising from each arm of the tegumen.

Pns Penis. The median intromittent organ composed of vesica and aedoeagus. It projects posteriorly between the arms of the vinculum.

Sc Sacculus. The basal heavily sclerotized portion of the clasper.

Sc Ex Sacculus Extension. A distal portion of the sacculus extending along the clasper ventral to the costa. Its dorsal margin forms the sclerotized median rod.

Tg Tegumen. The tergum of the ninth segment bearing the peniculi and the pedestal. It forms an inverted V.

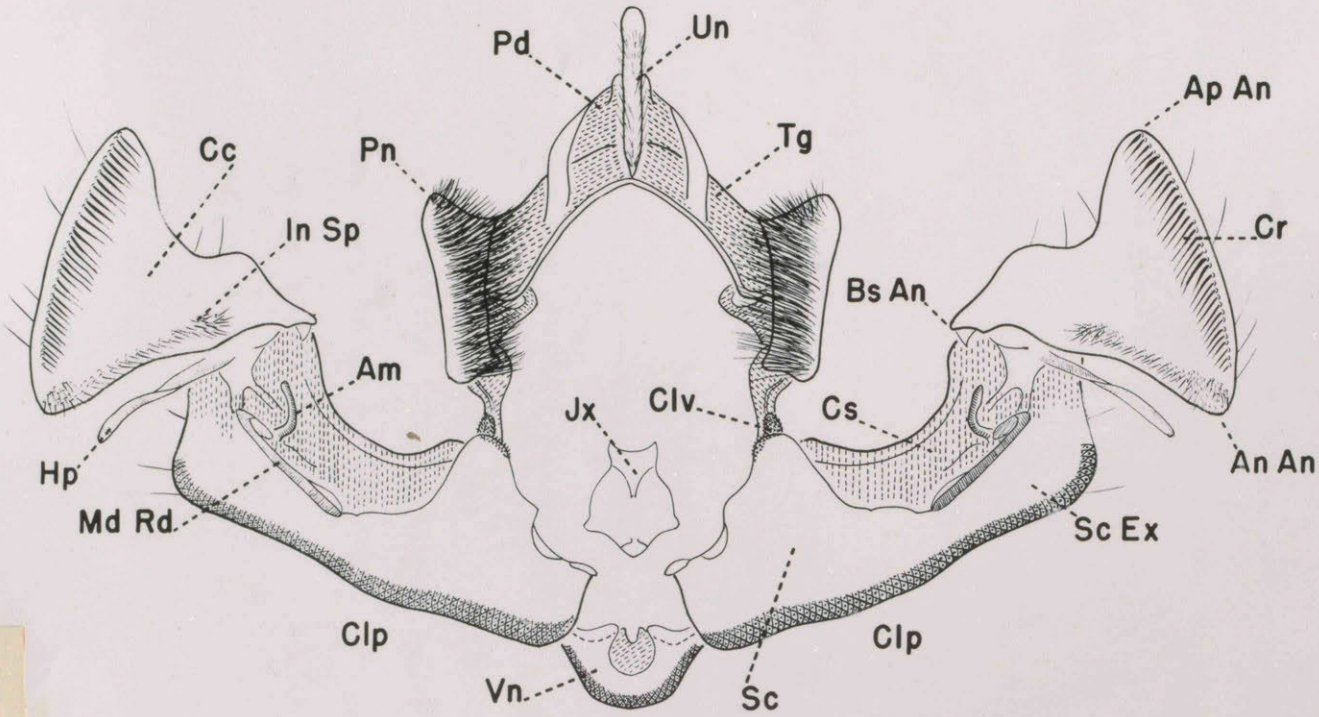
Un Uncus. A median, dorsal, finger-like flap or lobe that arises from the apex of the pedestal. It supposedly represents a definitive portion of the tenth somite.

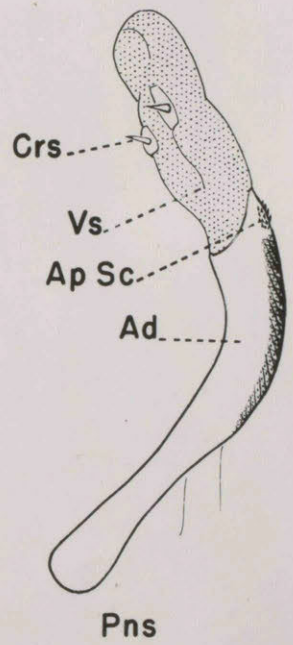
Vn Vinculum. A V- or U-shaped structure articulating dorsally with the tegumen. The claspers articulate with it. The vinculum is generally considered to represent the ninth sternum.

Vs Vesica. The preputial membrane. The terminal membranous portion of the penis which, when not in use, is folded within the aedoeagus.

PLATE I

External Male Genitalia of *Septis arctica* Frr.





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VII. DESCRIPTIONS OF GENITALIA

The following descriptions, as previously mentioned, are based upon specimens resident in the Canadian National Collection. On the average, the genitalia of three or four moths from each group were dissected out and studied. In a few cases up to a dozen genitalia of each species or "infra-species" were examined. Unfortunately, some descriptions are based on the genitalia of a single specimen, and it is readily admitted that this is somewhat scanty material on which to base a systematic description. The study was prosecuted to the full extent of available material, however, and it would seem wiser to include descriptions based on a single specimen than to omit them entirely.

The designation of infraspecific categories in the following descriptions are those employed by McDunnough in his 1938 check list of Lepidoptera, and they do not necessarily reflect the feelings of the writer as to the status of these categories. Races are designated according to McDunnough's system as a, b etc.

The sequence of species in the following descriptions is for the most part based on the structure of the male genitalia. Where no obvious relationship is indicated by the male genitalia the sequence followed is that of the McDunnough check list.

1. Septis cuculliformis Grt. (Plate II)

The uncus is broad, flattened, relatively short,

and moderately arched. It is somewhat contracted mesally and its apex is broadly rounded. The pedestal is well developed.

The tegumen is well arched. The peniculus is high and relatively narrow, and wider ventrally than dorsally. Its mesal margin is broadly concave. The vinculum is broadly rounded.

The juxta is well developed. Its lateral margins are deeply excavated above the lateral articulatory processes. The dorsal margin is broadly concave. The ventral angle is rounded.

The clasper is long, moderately narrow, and upcurved. The margins of the cucullus are of essentially equal length. The basal angle of the cucullus is somewhat produced to form a truncated protuberance. The apical and anal angles are rounded. The inferior spine mass is relatively broad dorsoventrally and extends from the anal angle, along the ventral margin of the cucullus for some two-thirds of its length.

The costa is large. The ampulla is long and slender. The harpe is moderately long, slender, and rounded. It terminates bluntly.

The sacculus is strong and the sacculus extension is broad. The clavus is expressed as a rounded shagreened protuberance of the dorso-mesal angle of the sacculus.

The aedoeagus is long and relatively slender and its apical scobinated area is circular and quite large. A moderately long, slender cornutus is borne at the apex of

vesica. Two long, slender, sclerotized arms extend onto the vesica from the apex of the aedoeagus. Each of these arms bears one, two, or three spines apically.

But three specimens were available for study, one from California, one from Washington, and one from Utah. The California specimen has three short spines upon the apex of one of the arms extending onto the vesica, and one upon the other arm. The Washington specimen has three and two, and each arm in the Utah specimen bears two. From this it would appear that a much more extensive series must be examined to determine the significance of this variability.

Cuculliformis does not appear to have any very close relatives among the members of the genus.

2. Septis spaldingi Sm. (Plate III)

The uncus is flattened, very broad, and but slightly arched. It is enlarged in the middle region and tapers gradually to a small, blunt apex. The pedestal is large.

The tegumen forms a broadly V-shaped arch. The peniculus is very large, and broader ventrally than dorsally. The vinculum is rounded ventrally.

The juxta is deeply excavated dorsally, and its lateral margins are excavated above the prominent lateral articulatory processes. Its ventral margin is broadly V-shaped.

The claspers are broad and strongly upcurved. The

inferior spine mass is extensive and occupies a large portion of the cucullus. Its component spines are very fine. The anal and apical angles of the cucullus are rounded and the basal angle forms a short, truncated protuberance as in cuculliformis. The dorsal margin of the cucullus is broadly and shallowly excavated.

The costa is large. The ampulla is long and stout, being about two thirds the length of the harpe. The harpe is quite short and is flattened.

The sacculus is not heavily sclerotized and the sacculus extension is moderately narrow. The clavus is expressed as a small, rounded, shagreened projection on the dorso-mesal angle of the sacculus.

The aedoeagus is long and slender and unembellished apically. The vesica is very small and bears subbasally a very stout recurved spine.

3. Septis nigrior Sm. (Plate III)

The uncus is slightly flattened and not arched. Its basal portion is greatly enlarged and serves as the point of attachment for large tufts of long hair. This basal portion is laterally rounded. The distal region of the uncus is moderately slender, and it is only slightly enlarged subterminally. The pedestal is large and broad.

The tegumen is broadly arched. The peniculus is moderately well developed. Its dorso-mesal angle is somewhat produced along the dorsal margin of the tegumen. The

vinculum is rounded ventrally.

The juxta is wider between the prominent lateral articulatory processes than it is in its dorsal region. The dorsal margin is weakly concave and the ventral margin is broadly V-shaped.

The claspers are broad basally and only weakly upcurved. The cucullus is large. Its dorsal and ventral margins are somewhat longer than the lateral margin. The ventral margin is broadly concave in its middle region and convex toward the basal angle. The dorsal margin is broadly excavated toward the apical angle and roundly humped toward the basal angle. The apical angle of the cucullus is rounded, the anal angle broadly rounded, and the basal angle obtusely pointed. The corona is well developed. The inferior spine mass is confined to the ventral margin of the cucullus laterally, but its mesal extremity penetrates the interior of the cucullus to some extent.

The costa is relatively small. The ampulla is reduced to a small projection. The harpe is moderately long, slender, rounded and strongly downcurved.

The sacculus is strong, and it is dorsally flattened. The sacculus extension is fairly broad and its ventral margin is bulged. The dorso-mesal angle of the sacculus is broadly rounded.

The aedoeagus bears a small scobinated area apically. To one side of this area a slender arm extends onto the vesica

with a strong spine at its apex. The vesica also bears a free apical spine.

4. Septis verbascoides Gn. (Plate III)

The external organs of verbascoides are very similar to those of nigrior, but differ in a number of details.

The basally expanded portion of the uncus is much broader and has prominent lateral shoulders. The distal portion of the uncus is somewhat more slender than that of nigrior and is diamond-tipped.

The tegumen of verbascoides is more highly arched than that of nigrior. The peniculus is similar to that of the former species. The vinculum is broadly rounded ventrally.

The dorsal portion of the juxta of this species, unlike that of nigrior, is as wide dorsally as between the lateral articulatory processes.

The clasper is of a similar shape to that of nigrior but the cucullus is somewhat larger. The inferior spine mass extends into the body of the cucullus for a greater distance than that of the former species.

The dorsal margin of the sacculus is broadly rounded rather than flattened as in nigrior. The clasper is bulged ventrally in the region of the sacculus extension, somewhat more so than that of nigrior.

The apical scobinated area of the aedoeagus is greatly reduced, being composed of only a few fine spicules.

The vesica, in addition to armature similar to that of nigrior, is equipped with a mass of very short cornuti in its middle region.

5. Septis vulgaris G. & R. (Plate III)

Vulgaris is more closely related to verbascoides than to nigrior.

The basal expanded portion of the uncus is more rounded laterally than that of verbascoides and its dorsal margin is more strongly convex. The slender distal shaft of the uncus is not diamond-tipped as in verbascoides.

The tegumen, the peniculus and the vinculum are similar to those of verbascoides.

The juxta is dissimilar from those of the previous two species in being wider dorsally than between the lateral articulatory processes. The plate also differs in being flattened dorso-ventrally in comparison with the relatively high juxta found in nigrior and verbascoides.

The clasper is practically the same as that of verbascoides, although the sacculus is not so strong.

The penis of vulgaris differs from that of the preceding species in having a more heavily scobinated area at the apex of the aedoeagus and in having two spines instead of one arising on the arm extending onto the vesica from the apex of the aedoeagus.

Nigrior, verbascoides, and vulgaris, because of the similarity of their male genitalia, appear to form a

distinct and well defined group.

6. Septis lignicolora Gn. (Plate IV)

The uncus is well arched, rounded, and very slender. It bears a small knob upon its sharp apical point. The pedestal of the uncus is not high.

The tegumen is broadly arched. The peniculus is well developed and quite high in relation to its width. Its ventro-lateral angle is broadly rounded. The ventral margin of the vinculum is broad and flattened.

The lateral articulatory processes of the juxta are prominent and rounded. The dorsal margin of the juxta is roundly excavated. The dorsal portion of the juxta is narrow in comparison with its width between the lateral articulatory processes. Ventro-mesally the juxta bears a small, rounded projection raised above the general surface of the plate.

The clasper is broad, tapering from the base to the apex of the costal area. The dorsal margin of the cucullus is deeply concave, giving the cucullus a trilobed appearance. The apical angle of the cucullus is rounded and the anal angle is acutely rounded. The corona is composed of a large number of relatively small spines. The inferior spine mass is composed of very slender spines and it is confined to the ventral margin of the cucullus. It extends from the anal angle along the ventral margin for some three-fifths of its length.

The costal area is large. The ampulla is long and

slender and strongly excurved. It may be somewhat bulbous terminally. The harpe is large, flattened, often twisted, and it terminates bluntly. It extends to or beyond a point equal to the anal angle of the cucullus.

The sacculus is large and heavily sclerotized. The clavus forms a large prominent dorsal lobe. It is not shagreened. The sacculus extension is narrow. The median rod has a mesally recurved portion that extends to the base of the ampulla.

The aedoeagus is unembellished apically. The large vesica bears two short cornuti in the middle region. One of these is borne on a long, slender, evanescent arm extending from the apex of the aedoeagus.

7. Septis lignicolora a quaesita Grt.

I am unable to distinguish the genitalia of this race of lignicolora from the foregoing.

8. Septis lignicolora b atriclava B. & McD. (Plate IV)

The genitalia of this race vary in a number of details from those of lignicolora. The uncus is stout. It is enlarged in the median region and tapers from this enlargement to the pointed apex, which, like that of lignicolora, bears a knob.

The tegumen, peniculus and vinculum are of essentially similar structure to those of lignicolora.

The juxta is much larger than that of lignicolora and it bears a prominent thumb-like protuberance that pro-

jects over the ventral margin of the plate. The clavus forms a prominent lobe as in lignicolora and it is finely shagreened.

The penis is similar to that of lignicolora but the aedoeagus bears a small scobinated area apically.

In view of these considerable differences in the male genitalia, atriclava might well be considered deserving of specific rank.

8. Septis antennata a purpurissata B. & McD.(Plate IV) (antennata Sm. was not available for study)

The uncus is stouter than that of lignicolora, but not nearly so stout as that of atriclava. The tegumen, the peniculus, and the vinculum are similar to those of lignicolora.

The juxta is considerably larger than that of lignicolora and the lateral articulatory processes, which are well rounded in the juxta of lignicolora, are truncated and prominent.

The clavus is more rounded than that of lignicolora and it is finely shagreened. At the base of the median rod there is a small thorn-like projection of the sacculus not found in lignicolora.

The penis of purpurissata is indistinguishable from that of lignicolora.

9. Septis genialis Grt.

On the basis of genitalia, this species appears to

be closely related to lignicolora. The uncus, however, is somewhat broader than that of the latter and it is strap-like. Subapically it tapers suddenly to a small point.

The clavus of this species is finely shagreened, as is that of purpurissata. The apex of the aedoeagus bears a well developed scobinated area as does that of atriclava. Otherwise the genital organs are like those of lignicolora.

10. Septis auranticolor Grt. (Plate IV)

The uncus is moderately stout and much like that of purpurissata. The tegumen, the peniculus and the vinculum are similar to those of lignicolora. The juxta is considerably larger than that of lignicolora, considering the overall smaller nature of the genitalia of auranticolor.

The ampulla is shorter than that of lignicolora, but otherwise the claspers are the same.

Apically the aedoeagus bears a small scobinated area, and the vesica is armed with two cornuti, neither of which are ever borne on any discernable arm.

11. Septis auranticolor a barnesi Sm.

Although smaller, the genitalia of barnesi are very similar to those of lignicolora. The uncus, however, is stouter, resembling that of auranticolor. The vinculum is usually not so flattened ventrally. The ventral prominence of the juxta of barnesi, unlike that of the remainder of the lignicolora group, is very poorly expressed.

The genitalia of barnesi may most readily be dis-

tinguished from those of lignicolora by the absence of the sclerotized arm extending onto the vesica. While this is often evanescent in lignicolora it is always discernable.

12. Septis auranticolor b sora Sm.

The genitalia of this race differ from those of auranticolor in having a larger, more heavily scobinated area at the apex of the aedoeagus and in having the clavus finely shagreened. The genitalia, in these respects, thus resemble those of genialis. The vesica, however, lacks the sclerotized arm as found in genialis.

It is apparent that a more thorough study must be made of lignicolora and auranticolor and the races of the latter. It is possible that barnesi and sora are worthy of specific rank.

13. Septis cinefacta a albertae Strand (Plate V)

The genitalia of this insect are much like those of auranticolor. The inferior spine mass, however, is somewhat broader dorso-ventrally. The apical scobinated area of the aedoeagus has a tendency to be dorso-ventrally flattened. A more reliable point of difference, however, is found in the armature of the vesica. In auranticolor both cornuti are borne in the middle region of the vesica whereas in albertae one is borne in the middle region and the other subbasally.

The genitalia of albertae are strikingly dissimilar to those of cinefacta, and the former insect would certainly not appear to be a race of the latter.

14. Septis commoda Wlk.

The genitalia of this insect are very similar to those of barnesi, differing only in one or two details. The ventral prominence of the juxta is well developed in commoda and very weakly developed, if at all, in barnesi. In barnesi both cornuti are borne in the middle region of the vesica whereas in commoda one is borne in the middle region and one subbasally.

15. Septis commoda a alberta Sm.

I cannot differentiate this race from commoda on the basis of the external male genitalia.

The foregoing eleven species and races form a compact group, whose members are often very difficult to distinguish on the basis of the male genitalia.

16. Septis grotei B. & McD.(Plate V)

Although the male genitalia of this species greatly resemble those of the lignicolora group, I consider them sufficiently divergent to exclude the species.

The uncus is considerably flattened whereas those of the foregoing group are perfectly tubular. The uncus is moderately slender and bulged subterminally, giving it a diamond-tipped appearance. It does not bear the apical knob typical of the lignicolora group.

The tegumen and the vinculum are of the same general nature as those of the lignicolora group.

The dorsal margin of the juxta is much broader,

equalling the width of the plate between the lateral articulatory processes. The ventro-mesal area of the juxta does not bear the rounded projection found in most of the species of the lignicolora group.

The clasper is like that of lignicolora but the clavus is finely shagreened and the harpe is rounded rather than flattened.

Apically the aedoeagus bears a very large, oval, coarsely scobinated area unlike any of those previously mentioned. In its middle region the vesica bears two small cornuti on small, free plates.

17. Septis inordinata Morr. (Plate V)

The uncus is mostly flattened, short, but slightly arched and moderately wide. It is slightly enlarged subapically. The pedestal is low and wide.

The tegumen is well arched. The peniculus is somewhat wider ventrally than dorsally. The vinculum is well rounded ventrally and a large portion of it is exposed below the claspers.

The juxta is small and the lateral articulatory processes are prominent. The dorsal margin is deeply and angularly excavated, giving the dorso-lateral angles an attenuated, wing-like appearance.

The clasper is upcurved. The cucullus is small in proportion to the rest of the clasper. The ventral margin is broadly and quite strongly convex, giving the basal

area of the cucullus an elongate, mesally truncated appearance. The inferior spine mass is large for the size of the cucullus and extends dorsally into the interior of the cucullus mesal to the corona.

The costa is moderately large. The harpe is stout and downcurved. The ampulla is greatly enlarged, being fully equal to the harpe in size.

The sacculus is strong and dorsally flattened. The clavus is specialized as a small, rounded, coarsely shagreened lobe. The sacculus extension is moderately narrow.

The aedoeagus bears at its extreme apex a well developed scobinated area. The vesica bears apically two large, diametrically opposed, slightly downward projecting spines.

18. Septis inordinata a montana Sm.

The genitalia are indistinguishable from the foregoing species.

19. Septis inordinata b columbiae Strand

I cannot differentiate the genitalia of this race from those of inordinata.

20. Septis cinefacta Grt. (Plate V)

The uncus is very short, moderately stout, and somewhat enlarged subterminally. Apically it forms a small, truncated point. The pedestal is very low and dorsally rounded.

The tegumen is moderately arched. The peniculus is of medium size and the ventro-mesal angle is produced into a broad lobe.

The vinculum is high and a large portion is exposed ventral to the claspers. It is sharply pointed ventrally.

The juxta is large. Its ventral margin is broadly rounded except for a small mesal point. The dorsal margin is but slightly concave. The lateral margins are for the most part straight, the articulatory processes forming but slight lobes.

The clasper is moderately broad basally but very narrow in the region of the apex of the mesoclasper. The cucullus is small. The dorsal and ventral margins of the cucullus are considerably longer than the lateral margin. Both dorsal and ventral margins are broadly excavated, reducing the basal region of the cucullus to a narrow peninsula. The inferior spine mass is very large, occupying a considerable portion of the body of the cucullus.

The costa is greatly narrowed between the median rod and the costal margin. The ampulla is moderately short and stout. The harpe consists of a bulbous, basal portion from which the nipple-like, distal portion projects.

The sacculus is large and well sclerotized. The sacculus extension is narrow. The peniculus has no very definite structure but it usually consists of some type of coarsely shagreened projection.

The aedoeagus is large and stout. Upon its apex is a very extensive scobinated area. The vesica bears but one cornutus in the form of a stout spine projecting from the middle portion of a broad arm extending onto it from the apex of the aedoeagus.

21. Septis albina Grt. (Plate VI)

The uncus is long, moderately slender, but somewhat enlarged basally and subapically. The pedestal is large and almost quadrangular.

The tegumen is but slightly arched. The dorsal portion of the peniculus is larger than the ventral portion, and as a result the mesal margin has a double arcuate appearance. The vinculum is well rounded ventrally.

The juxta is moderately small. It has a small V-shaped excavation dorsally. From the prominent lateral articulatory processes the lateral margins slope to the narrow dorsal portion of the juxta. The ventral margin of the sclerite is irregular.

The clasper is long and narrow. The cucullus is moderately large. The dorsal and ventral margins of the cucullus are broadly convex, making the basal area of the cucullus narrow. The anal and apical angles of the cucullus are rounded. The basal angle of the cucullus bears a short, finger-like process. The inferior spine mass is large and oval and extends into the body of the cucullus.

The costa is narrow basally but it widens toward

its apex. The ampulla is small and projects from beneath the median rod. The harpe is broad basally, but tapers to a narrow apex.

The sacculus is moderately strong. The sacculus extension is broad basally but tapers to a narrow apex. The clavus is expressed as a small, rounded, unshagreened lobe.

The aedoeagus is long and slender and unembellished apically. The vesica is very large and it bears no free cornuti. A short sclerotized arm bearing two small spines extends onto the vesica from the apex of the aedoeagus.

22. Septis arctica Frr. (Plate I)

The uncus is long, moderately well arched, and uniformly slender. It is pointed apically. The pedestal is moderately low and dorsally rounded.

The tegumen is strongly and roundly arched. The peniculus is high and for the most part narrow, but it is somewhat enlarged dorsally. The vinculum is almost flattened ventrally.

The juxta is high and relatively narrow. It is widest between the lateral articulatory processes.

The clasper is broad, relatively short, and only weakly upcurved. The cucullus is large and the margins are of essentially equal length. The dorsal margin is somewhat excavated mesal to the apical angle. The apical and anal angles are broadly rounded. The basal angle is more or less pointed. The inferior spine mass is dorso-ventrally narrow

and confined to the ventral margin of the cucullus along which it extends for some three-quarters of its length from the anal angle.

The costa is large. The ampulla is moderately long, slender, and excurved. The harpe is long and slender and mostly flattened.

The sacculus is well developed. The clavus is shagreened and may or may not have a free thumb-like projection. The sacculus extension is large and given a somewhat triangular appearance by the presence of a bulge in the ventral margin of the clasper opposite the median rod.

The aedoeagus is slender and bears a small, rounded, scobinated area apically. In the median region of the vesica are borne two small cornuti upon sclerotized plates.

23. Septis arctica aberrant formosus Ells.

The genitalia are similar to those of arctica.

24. Septis castanea Grt.

I cannot differentiate the genitalia of this species from those of the foregoing.

25. Septis castanea form cymosana Strand

The genitalia are the same as those of the typical form.

26. Septis occidens form coloradensis Strand (Plate VI)
(occidens Grt. was not available for study)

The uncus is slender, but slightly arched and con-

tracted in its middle region. It is apically pointed. The pedestal is quite high.

The tegumen is broadly and but slightly arched. The peniculus is well developed. The vinculum is broadly rounded.

The juxta is diamond-shaped.

The clasper is moderately wide and but weakly upcurved. The cucullus is of moderate size and all of the margins are of essentially equal length. The dorsal margin is broadly but shallowly excavated. The apical and anal angles are rather sharply rounded and the basal angle is broadly truncated. The inferior spine mass is moderately large, somewhat oval in shape, and confined to the anal area of the cucullus.

The costa is large. The ampulla is long and slender. The harpe is long, flattened, and often twisted. It extends to a point at least equal with that of the anal angle.

The sacculus is not particularly strong. The peniculus forms a broad, low, unshagreened lobe. The sacculus extension is moderately narrow and its ventral margin is slightly bulged opposite the median rod.

The aedoeagus bears a large, recurved spine subapically. The vesica is decorated with two small cornuti borne on small plates in the median region.

27. Septis finitima Gn. (Plate VI)

The uncus is long, flattened, and but slightly arched. It is relatively narrow basally but bulbous subapically. It terminates bluntly. The pedestal is low, wide and rounded.

The tegumen is well arched, and the vinculum is broadly rounded.

The juxta is dorso-ventrally elongated. Its dorsal margin is weakly concave, and its lateral margins are concave between the dorso-lateral angles and the lateral articulatory processes. The ventral margin is broadly V-shaped.

The clasper is moderately narrow, long and upcurved. The dorsal margin of the cucullus is excavated for most of its length, but humped toward the basal angle, giving the mesal portion of the cucullus a truncated appearance. The inferior spine mass is relatively small, extending from the anal angle along the ventral margin of the cucullus for only half its length.

The ampulla is long and slender. The harpe is long, broad and greatly flattened. It terminates bluntly.

The sacculus is strong. The clavus forms a broadly rounded dorsal lobe. On the mesal margin of the cucullus there arises a heavily sclerotized, slender pinnacle-like projection. It is of irregular form and may be armed with short teeth apically.

The aedoeagus bears apically a relatively large, coarsely scobinated area. The vesica bears two stout

cornuti on relatively large plates. In some specimens, one of these cornuti is bifid. Evidently further study is necessary to determine the significance of this variability.

28. Septis finitima a cerivana Sm.

I cannot distinguish this western race from the eastern one on the basis of genitalia. The penis shows the same variability as to the single or bifid nature of one of the cornuti.

29. Septis plutonia Grt. (Plate VI)

The extreme base of the uncus is moderately broad but the long distal shaft is very slender. It terminates bluntly. The pedestal is broad, moderately low and rounded.

The tegumen is but slightly arched. The peniculus is a very large, broad lobe. The vinculum is well rounded ventrally.

The juxta is a small, weakly sclerotized plate. Its dorsal margin is convex. The lateral margins are irregular and the lateral articulatory processes not very prominent. The ventral margin is broadly V-shaped.

The weakly upcurved clasper is small, except for the very large cucullus. The dorsal margin of the cucullus has a large, rounded bulge in its middle region. The ventral margin has a slight bulge in the region of the mesal extremity of the inferior spine mass. The anal and apical angles are rounded and the basal angle is pointed. The inferior spine mass is greatly reduced and consists of a

few rows of spines extending along the ventral margin for most of its length.

The costa is small. The ampulla is very slender and at least as long as if not longer than the harpe, which is reduced to a short, moderately slender arm.

The sacculus is but weakly sclerotized. The clavus forms a broad, rounded lobe that is finely shagreened on its dorsal surface. The sacculus extension is large and its ventral margin is greatly bulged opposite the median rod.

At its extreme apex the aedoeagus bears a small, circular scobinated area. The armature of the vesica consists of two subapical cornuti and a spine borne upon a short, sclerotized arm extending onto the vesica.

30. Septis vultuosa Grt. (Plate VII)

The genitalia of this species are very similar to those of the foregoing.

The uncus, however, is broad and flattened. It is somewhat constricted in its middle region and broadly diamond-tipped. The pedestal is high and almost triangular.

The tegumen is a narrow strap between the peniculi and it is but poorly arched. The peniculus is large and similar to that of the former species. The vinculum is rounded ventrally, as is that of plutonia. The juxta is broadly concave dorsally. Its lateral margins are irregular and the lateral articulatory processes are somewhat more prominent than those of the former species.

The claspers are similar to those of plutonia except for certain small differences. The cucullus is not so large and its dorsal margin is excavated toward the apical angle and humped toward the basal angle, giving the cucullus a flattened appearance mesally. The anal angle of the cucullus is pointed and the apical angle is rounded.

The penis is indistinguishable from that of plutonia.

Plutonia and vultuosa, because of the similarity of their male genitalia, would seem to be closely related.

31. Septis alia Gn. (Plate VII)

The uncus is very broad basally but considerably more slender distally. It is somewhat enlarged subapically and is terminally pointed. The pedestal is high.

The tegumen is only slightly arched. The peniculus is large and its dorso-lateral angle forms a prominent rounded lobe. The vinculum is ventrally flattened and little of it is exposed ventral to the claspers.

The juxta resembles a broad, flattened V, being very low and wide. It is convex dorsally and pointed ventrally and its short lateral margins are quite regular.

The clasper is narrow, especially so in the region of the apex of the costa, and only weakly upcurved. The dorsal margin of the cucullus is broadly excavated toward the apical angle and narrowly humped toward the basal angle. The apical angle is broadly rounded, the anal angle acutely

rounded, and the basal angle pointed. The inferior spine mass forms a narrow strip along the ventral margin of the cucullus, and its mesal extremity penetrates the interior of the cucullus for a short distance.

The costa is narrow. The ampulla is short and mostly slender but sometimes enlarged in its middle region. The harpe is bifurcate. The outer arm is short, slender, and rounded. It projects downward. The inner arm arises dorsally from the base of the outer arm. It is only about half the length of the outer arm.

The dorsal margin of the sacculus is broadly rounded. The clavus is not expressed. The sacculus extension is much broader than the costa and its ventral margin is bulged opposite the apex of the median rod.

The small apical scobinated area of the aedoeagus is greatly flattened dorso-ventrally. The armature of the vesica consists of three cornuti. One of these is borne apically and two in the middle region. One of the median cornuti consists of two thorn-like projections arising from a single small sclerotized plate.

32. Septis alia form rorulenta Sm.

I cannot distinguish the genitalia from those of the typical form.

33. Septis impulsa Gn. (Plate VII)

The uncus is broad, very flat, and well arched. It is slightly constricted in the middle region. Distally

it tapers suddenly to a small terminal point. The pedestal is low and not very wide.

The tegumen is moderately arched. The peniculus is small in comparison with that of alia. The vinculum is broadly rounded ventrally.

The dorsal margin of the juxta is broadly concave. The lateral margins of the juxta are irregular and the lateral articulatory processes are moderately prominent. The ventral margin is broadly V-shaped.

The clasper is short and broad for its length. The cucullus is large and the margins are of essentially equal length. The dorsal margin is broadly excavated toward the apical angle and somewhat humped toward the basal angle. The apical and anal angles are broadly rounded and the basal angle is broadly truncated. The inferior spine mass is relatively large and extends from the anal angle across the cucullus for some two thirds the length of the ventral margin.

The costa is large. The ampulla is long and slender. The harpe is long, slender, usually flattened, and often twisted. It is blunt apically.

The sacculus is relatively weak for the size of the clasper. The clavus is a broad, rounded, very finely shagreened dorsal lobe. It may or may not have a free thumb-like projection. The sacculus extension is broad and its ventral margin is somewhat bulged.

The penis is small. The aedoeagus bears apically

a small, round, scobinated area. The vesica bears two free cornuti and two others are borne upon short sclerotized arms extending from the apex of the aedoeagus. One of the latter is an ordinary short spine while the other is a large, comb-like, heavily sclerotized process.

34. Septis indocilis Wlk. (Plate VII)

The genitalia of this species are very similar to those of the foregoing, differing only in a few small details.

At the base of the median rod there is a flattened, thorn-like structure which is never present in impulsa.

The penis is similar to that of the foregoing species although it is usually somewhat larger. The armature of the vesica is the same except that the spine which is borne at the apex of one of the arms in impulsa is absent in indocilis. The arm itself, however, is present.

35. Septis indocilis form separans Grt.

The genitalia of this form are similar to those of the typical one.

36. Septis indocilis a runata Sm.

I cannot distinguish this race of indocilis from indocilis itself.

37. Septis indocilis form enigra Sm.

This form cannot be separated from the foregoing on the basis of the male genitalia.

38. Septis ampliata McD.

The genitalia of this insect are very similar to those of the two former species. They may be distinguished from those of impulsa, however, by the presence of the thorn-like projection at the base of the median rod and from indocilis by the presence of the small spine at the apex of one of the short sclerotized arms extending onto the vesica.

39. Septis mixta Grt. (Plate VIII)

The uncus is arched but slightly, if at all. It is bulbous basally but the long distal portion is slender. It may be somewhat enlarged subterminally and it is apically pointed. The pedestal is triangular and moderately high.

The tegumen is broad and moderately arched. The peniculus is well developed. Its dorso-lateral angle is obtusely rounded, and its dorso-mesal angle is drawn out into a long fold along the dorsal margin of the tegumen. The vinculum is well rounded ventrally.

The juxta is dorso-ventrally elongated. Its dorsal portion is very narrow. The plate is broadest between the lateral articulatory processes. Its ventral margin has a small sharp point mesally.

The clasper is moderately narrow and strongly upcurved. The cucullus is of medium size. Its dorsal and lateral margins are regular and its ventral margin only slightly irregular. The apical and anal angles are broadly rounded and the basal angle is truncated. The inferior spine

mass is large and composed of very coarse spines. It extends dorsally mesal to the corona for a considerable distance.

The costa is narrow. The ampulla is short and usually somewhat bulbous apically. The harpe is reduced to a very short, slender projection.

The sacculus is rather weak. The clavus forms a rounded, unshagreened lobe. The sacculus extension is broad and its ventral margin is rounded.

The aedoeagus is long and slender and unembellished apically. The vesica is an extremely long, slender, membranous tube which bears a long stout cornutus apically.

40. Septis apamiformis Gn. (Plate VIII)

The basal portion of the uncus is greatly enlarged, is flattened dorsally, and has large rounded lateral shoulders. The distal portion is moderately stout and of a uniform diameter. It tapers subapically to a small truncated point. The pedestal is very large.

The tegumen is moderately well arched. The peniculus is very large. Its dorso-lateral angle is produced to form a broad protuberance. The vinculum is broadly rounded ventrally.

The juxta is relatively small. Its dorsal margin is but slightly excavated. Its lateral margins are rounded and the lateral articulatory processes are inconspicuous. The ventral margin is broadly V-shaped.

The clasper is long and but slightly upcurved. The cucullus is large and all its margins are of essentially equal length. The dorsal margin is excavated toward the apical angle and broadly bulged toward the basal angle. The apical, anal, and basal angles are all rounded. The inferior spine mass is very large and consists of very coarse spines. It is broad dorso-ventrally and extends from the anal angle along the ventral margin for three-quarters of its length.

The costa is very narrow basally, becoming wider towards its apex. The ampulla is entirely absent. The harpe is bifurcate. Both arms are very short. The longer arm curves mesally over the costal margin, and the shorter one curves outward and downward.

The sacculus is not large, and it is flattened dorsally. The mesal angle of its dorsal margin is scobinated. The sacculus extension is broad and of regular width throughout.

The apical scobinated area of the aedoeagus is small. The vesica is armed with three cornuti. One of these is borne apically and one in the middle region. The third, a strong bifid process, is borne on a short sclerotized arm extending from the apex of the aedoeagus.

41. Septis cariosa Gn. (Plate VIII)

The uncus is somewhat flattened and extremely broad. The basal portion is bulbous. It is constricted in the median region, and the distal portion greatly resembles

a fountain pen nib. The pedestal is high and very broad.

The tegumen is moderately well arched. The peniculus is relatively small, and its dorso-lateral and ventro-lateral angles are broadly rounded. The vinculum is rounded ventrally.

The juxta is concave dorsally. Its lateral margins are irregular and the lateral articulatory processes form conspicuous, sharp projections. Its ventral margin is broadly V-shaped.

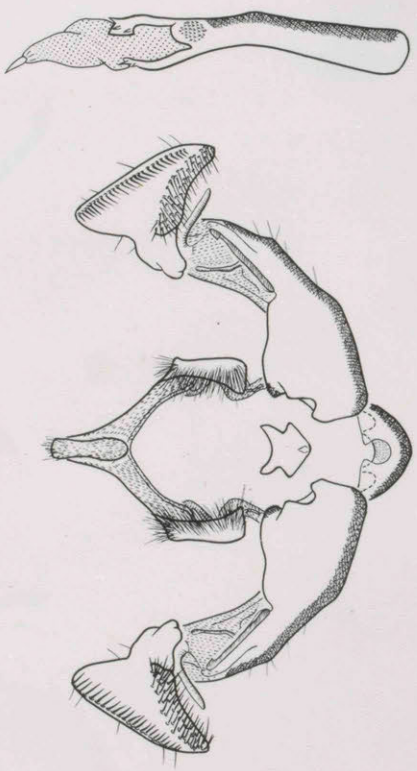
The clasper is long and narrow, and only weakly upcurved. The cucullus is set at an oblique angle at the apex of the costa. Its dorsal and ventral margins are longer than the lateral margin. The dorsal margin is very irregular, being convex toward the apical angle and excavated toward the basal angle. The apical and the anal angles are rounded, and the basal angle is broadly truncated. The corona is reduced, being confined to the dorsal two-thirds of the lateral margin. The inferior spine mass is represented only by two large spurs. One of these is located on the anal angle and the other dorsal to it.

The costa is moderately narrow. Both ampulla and harpe are reduced to mere nipple-like protuberances.

The sacculus is very weakly sclerotized, and the clavus is evident as a broadly rounded, unshagreened dorsal lobe. The sacculus extension is moderately narrow, and its ventral margin is bulged opposite the apex of the median rod.

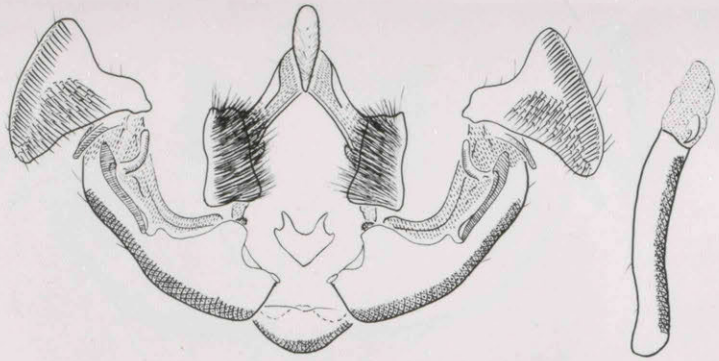
The aedoeagus bears apically a circular, scobinated

PLATE II

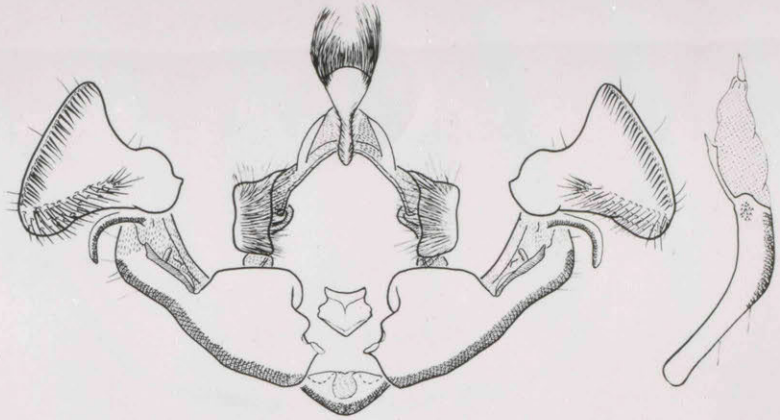


cuculliformis Grt.

10 X

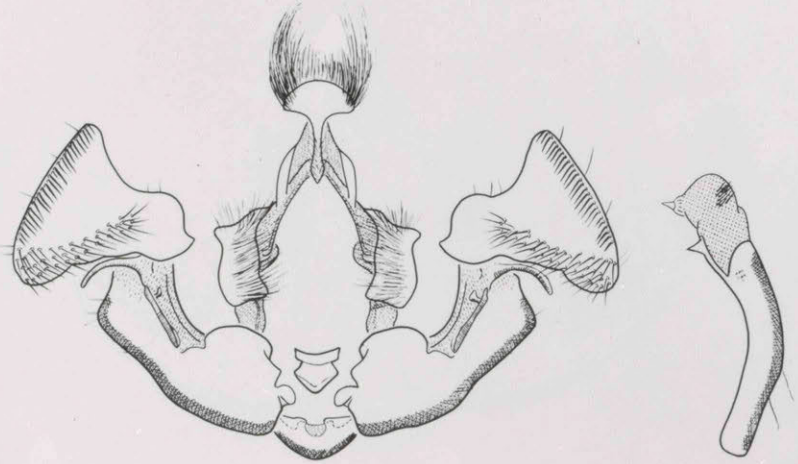


spaldingi Sm.

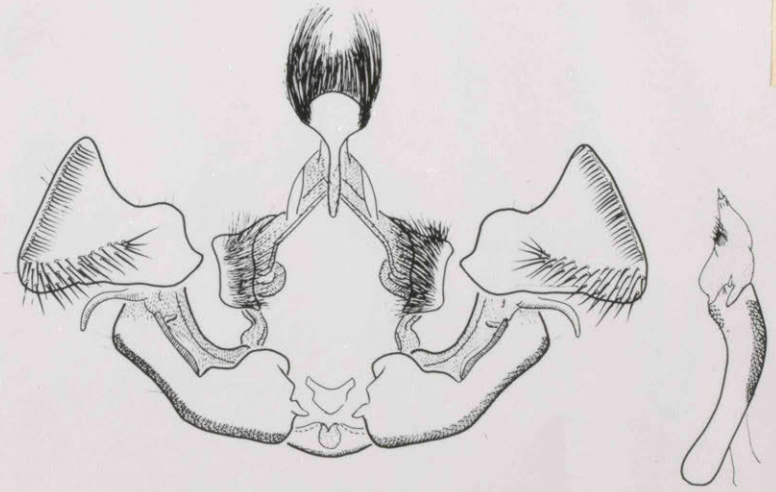


nigrior Sm.

PLATE III

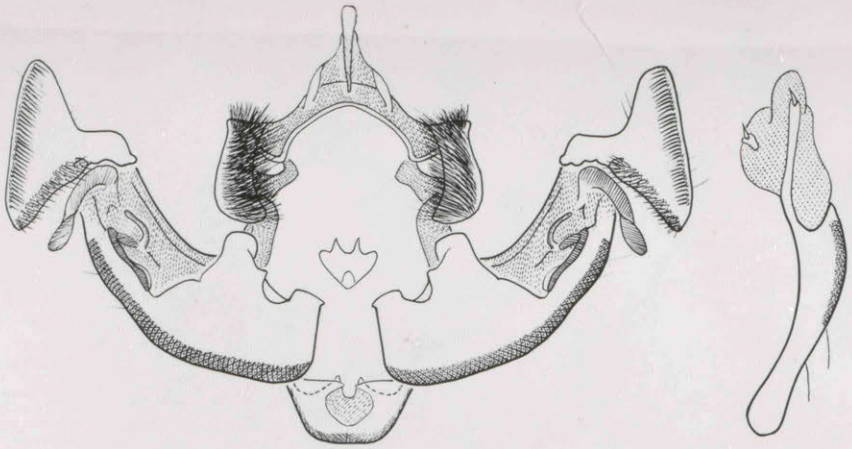


verbascoides Gn.

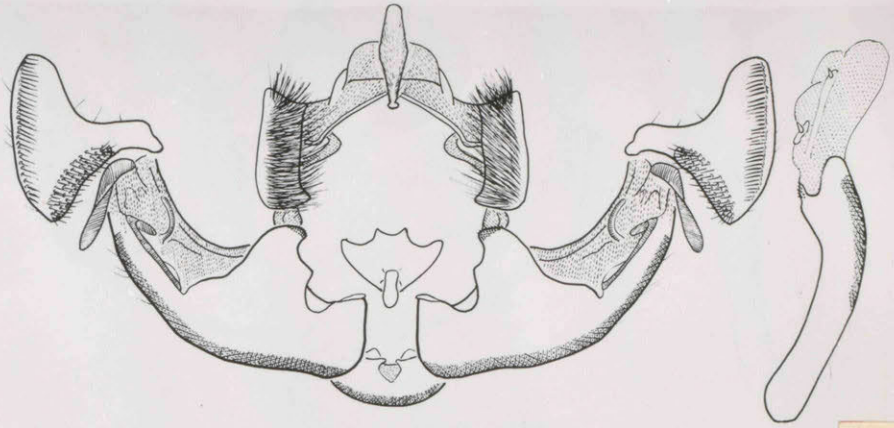


vulgaris G. & R.

X 10

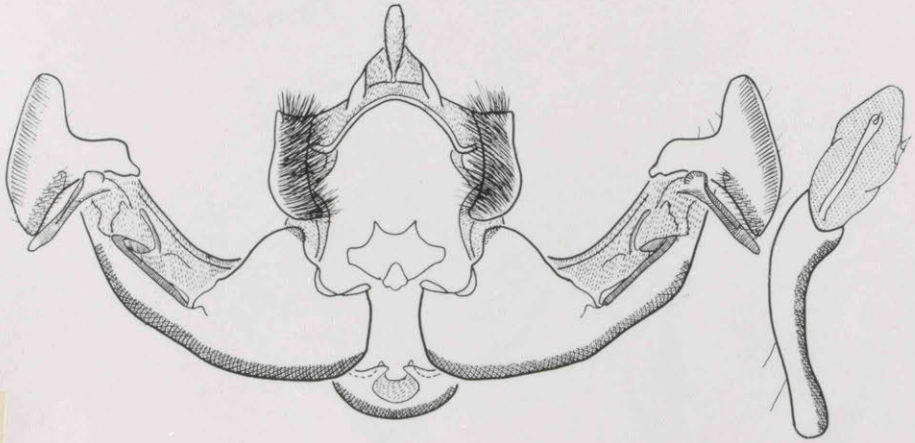


lignicolora Gn.

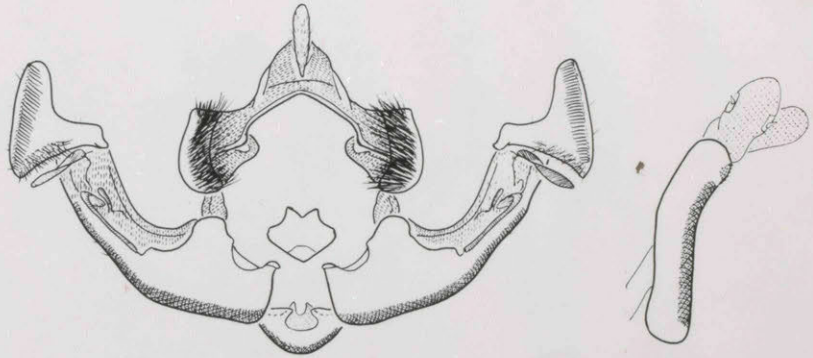


lignicolora b atriclava B. & McD.

PLATE IV

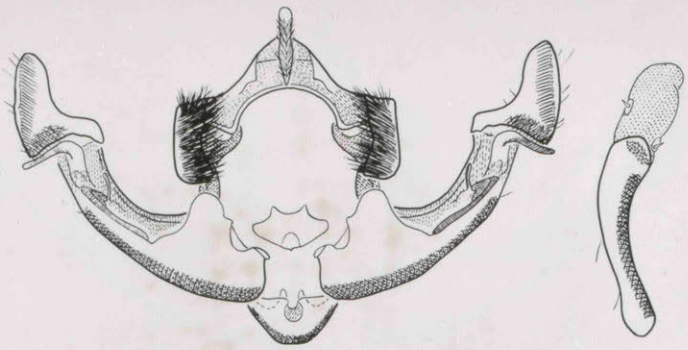


antennata a purpurissata B. & McD.

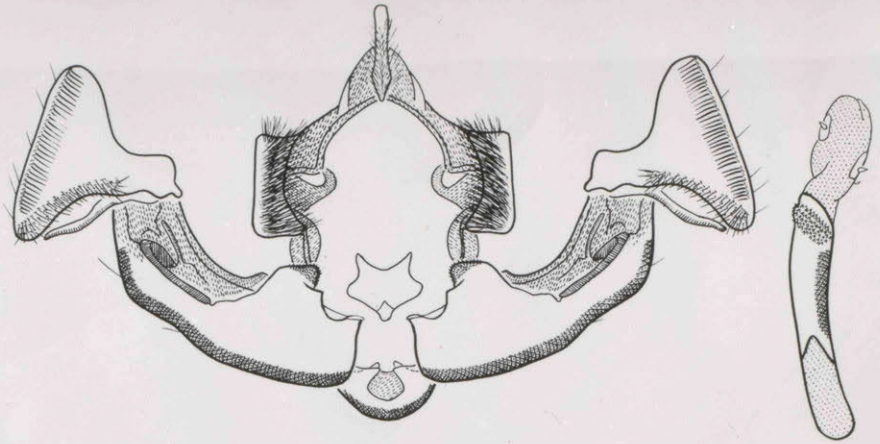


auranticolor Grt.

X 10

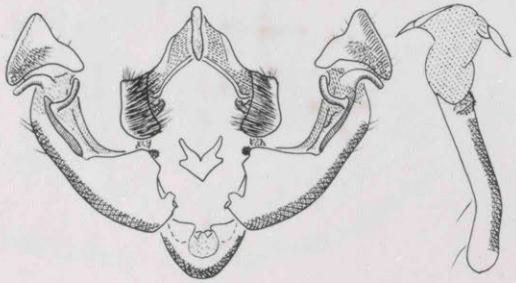


cinefacta a albertae Strand

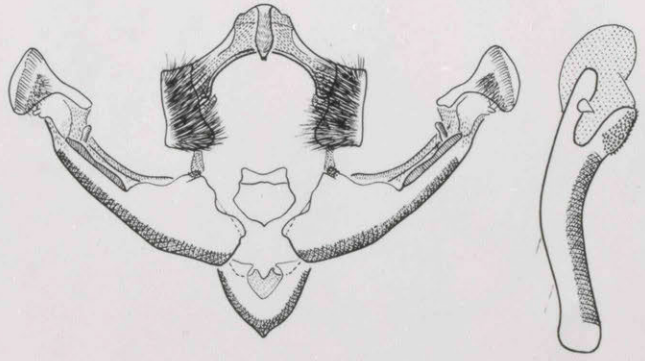


grotei B. & McD.

PLATE V

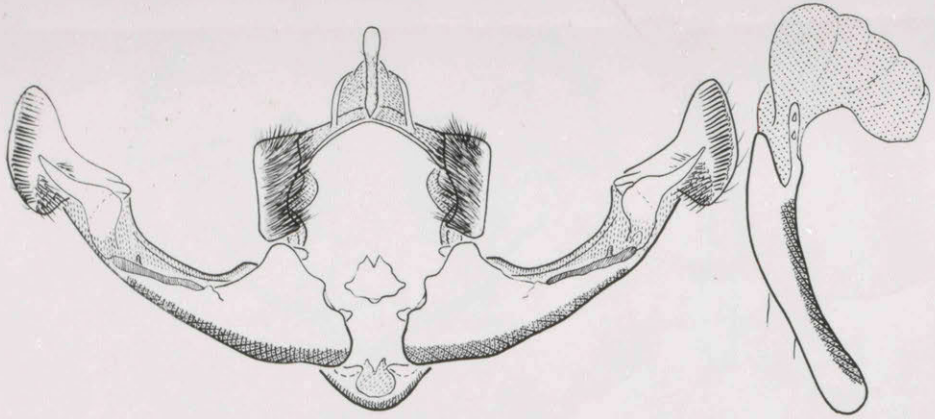


inordinata Morr.

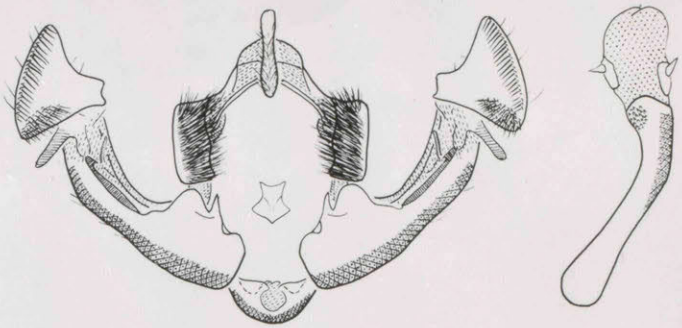


cinefacta Grt.

10 X

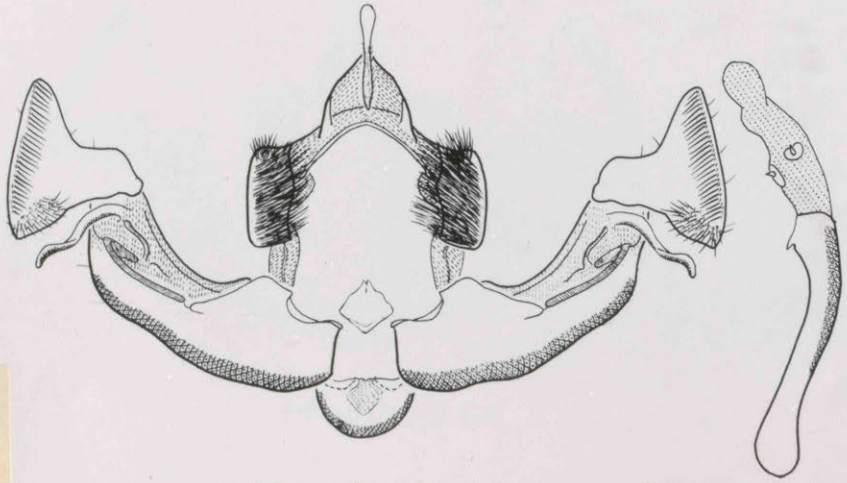


albina Grt.



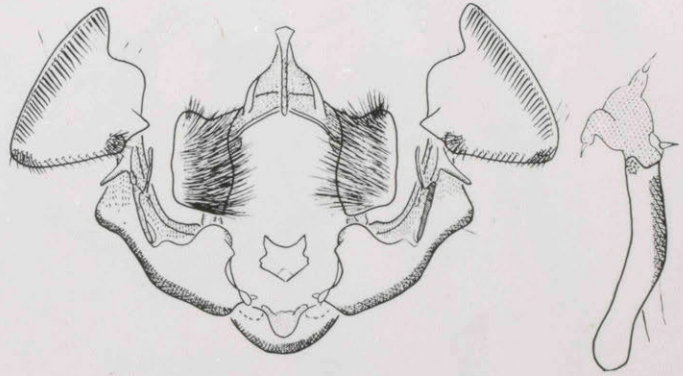
finitima Gn.

PLATE VI

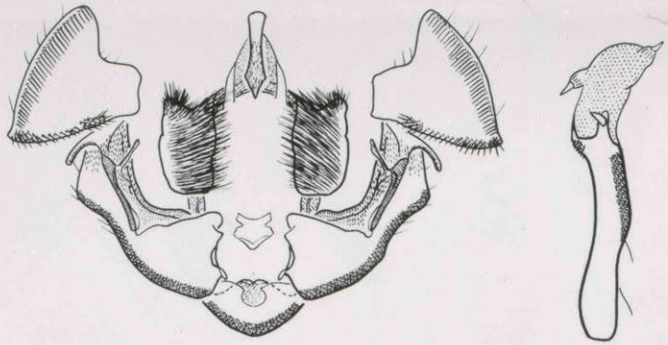


occidens f. coloradensis Strand

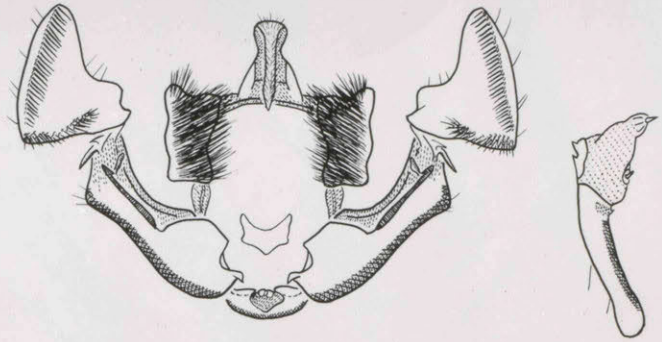
10 X



plutonia Grt.

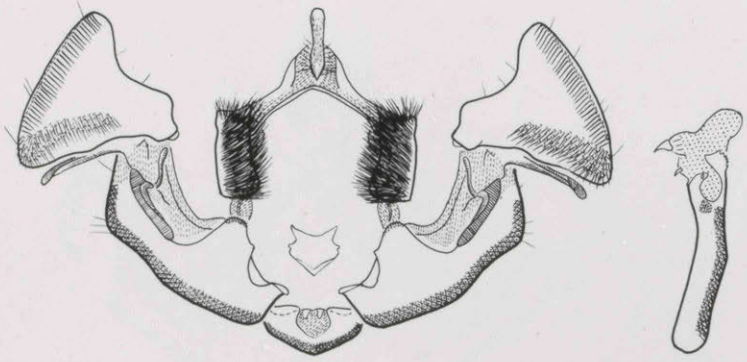


vultuosa Grt.

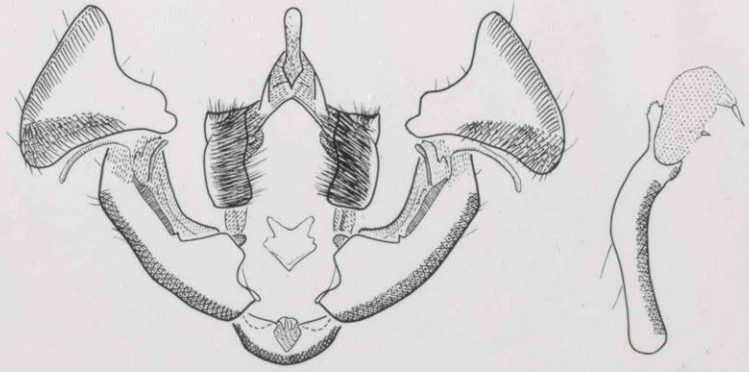


alia Gn.

PLATE VII

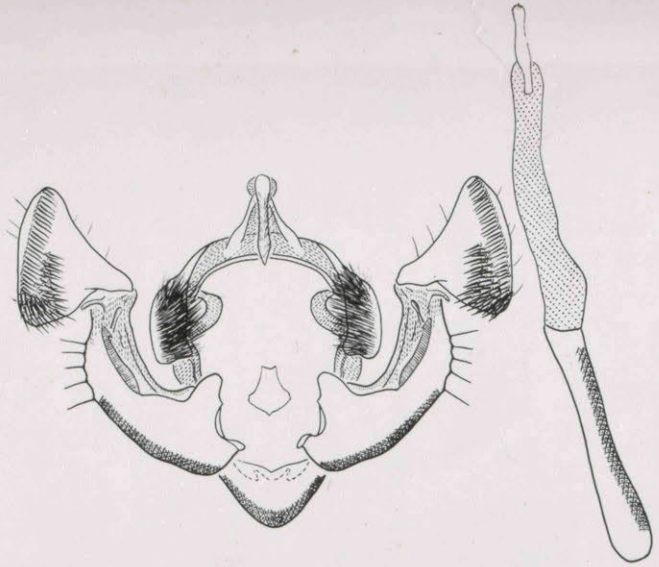


impulsa Gn.

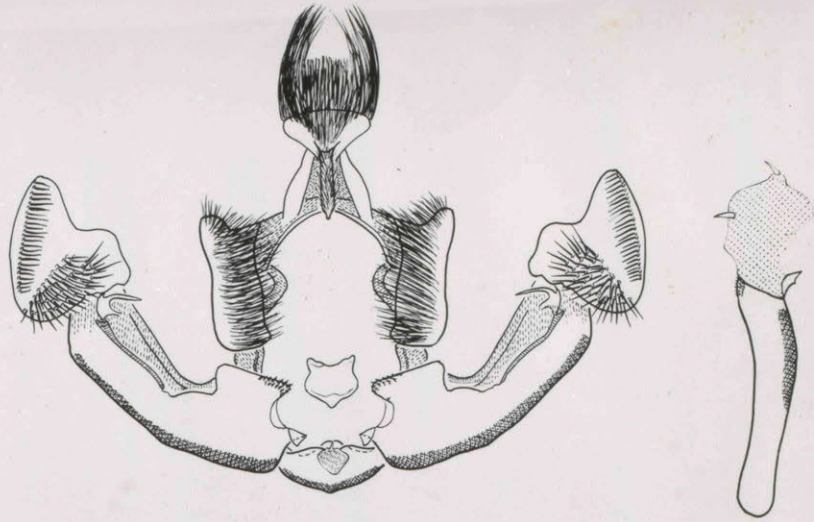


indocilis Sm.

10 X

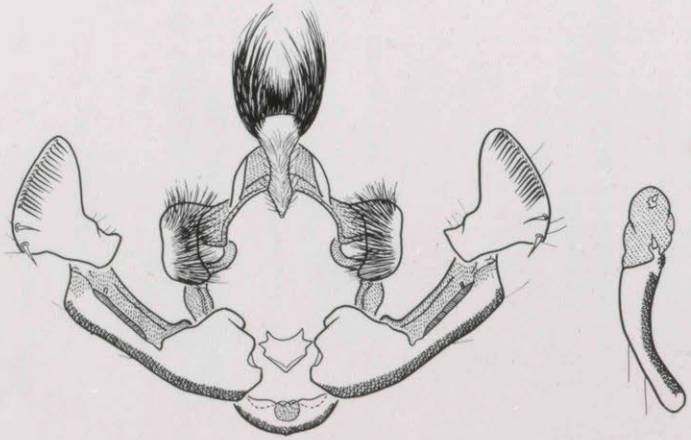


mixta Grt.

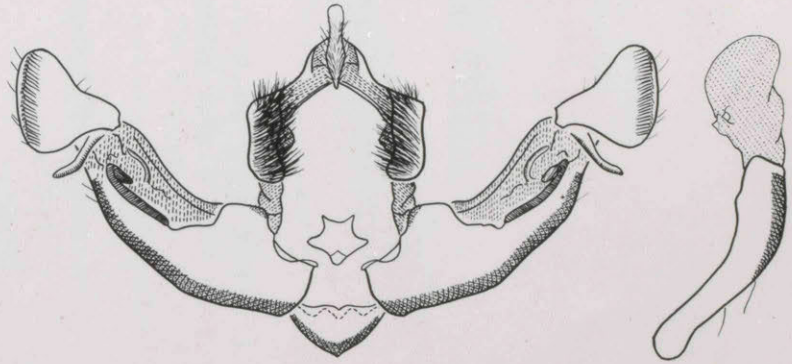


apamiformis Gn.

PLATE VIII



cariosa Gn.



relicina Morr.

10 X

minent, broad, dorsal lobe and it is finely shagreened mesally. The sacculus extension is relatively narrow.

The aedoeagus is unembellished apically. The large vesica bears two small cornuti in its median region.

VIII. KEY TO SPECIES STUDIED

1a. inferior spine mass absent..... 2

b. inferior spine mass present..... 3

2a. inferior spine mass represented by two very large spines, one located on the anal angle and the other dorsal to it; harpe reduced to a nipple-like protuberance.....(p.48) cariosa Gn.

b. cucullus bare of spines except for corona; harpe well developed.....(p.50) relicina Morr.

3a. vesica longer than aedoeagus.....(p.46) mixta Grt.

b. vesica not nearly so long as aedoeagus..... 4

4a. spines of inferior spine mass coarser than those of corona.....(p.47) apamiformis Gn.

b. spines of inferior spine mass no coarser than those of corona, usually not nearly so coarse..... 5

5a. harpe single..... 6

b. harpe bifurcate.....(p.42) alia Gn.

6a. vesica very small and armed with but one very large, very stout, recurved spine.....(p.21) spaldingi Sm.

b. armature of vesica not as above..... 7.

7a. vesica with no free cornuti but with a single sclerotized arm extending onto it from the apex of the aedoeagus..... 8

b. vesica with one or more free cornuti..... 9

8a. vesica very large; sclerotized arm extending onto it from apex of aedoeagus with two short spines; apical scobinated area of aedoeagus absent....(p.35) albina Grt.

8b. vesica relatively small; sclerotized arm extending onto vesica with but one moderately large spine; apical scobinated area of aedoeagus very large..... .....(p.33) cinefacta Grt.

9a. uncus broad, flattened, and obtusely rounded apically; vesica with one free cornutus at apex; two sclerotized arms extend onto vesica from apex of aedoeagus, one to either side of apical scobinated area; each of these arms bears one, two or three spines..... .....(p.19) cuculliformis Grt.

b. not as in 9a..... 10

10a. uncus with greatly expanded basal portion and slender distal portion..... 11

b. uncus without greatly expanded basal portion..... 13

11a. vesica with a mass of fine cornuti..... 12

b. vesica without mass of fine cornuti....(P.22) nigrior Sm.

12a. long arm extending onto vesica from apex of sacculus bearing one well developed spine; apical scobinated area of aedoeagus much reduced....(p.24) verbascoides Gn.

b. arm extending onto vesica with two small spines; apical scobinated area of aedoeagus well developed. .....(p.25) vulgaris G. & R.

13a. vesica bearing only two cornuti; either two free cornuti or one free cornutus and a spine borne upon a sclerotized arm extending from apex of aedoeagus. 14

b. vesica with more than two cornuti..... 27

14a. ampulla at least as large as harpe..... .....(p.32) inordinata Morr.

b. ampulla not nearly so large as harpe..... 15

15a. aedoeagus bearing one large spine in the position normally occupied by apical scobinated area..... .....(p.37) occidens f. coloradensis Strand.

b. apex of aedoeagus without large spine subapically.. 16

16a. dorsal margin of cucullus deeply and broadly excavated, giving the basal region of cucullus an attenuated and mesally truncated appearance..... 18

b. dorsal margin of cucullus not deeply excavated..... 17

17a. mesal margin of sacculus bearing an elongate, irregular, heavily sclerotized projection.....
.....(p.38) finitima Gn.

b. mesal margin of clasper without heavily sclerotized projection.....(p.36) arctica Frr.

18a. apex of aedoeagus without scobinated area.....19

b. apex of aedoeagus with scobinated area..... 22

19a. clavus shagreened.....
.....(p.28) antennata a purpurissata B. & McD.

b. clavus not shagreened..... 20.

20a. one of the two cornuti of vesica borne on long slender arm, which although evanescent in some specimens is always discernable; uncus long and very slender
.....(p.26) lignicolora Gn.

b. both cornuti of vesica free; uncus moderately stout 21

21a. one of the two cornuti borne in the middle region of the vesica, the other borne subbasally; juxta with a ventral prominence in the form of a rounded lobe raised above the general plane of the sclerite
.....(p.31) commoda Wlk.

b. both cornuti borne in the middle region of the vesica; ventral prominence of juxta very poorly expressed, only slightly raised above the general plane of the sclerite, if at all.....
.....(p.29) auranticolor a barnesi Sm.

22a. clavus shagreened..... 23

b. clavus not shagreened..... 26

23a. uncus very stout and bulged in the middle region; meso-ventral area of juxta bearing a prominent thumb-like process, which extends over the ventral margin of the plate.....
.....(p.27) lignicolora b atriclava B. & McD.

b. uncus not very stout; no free thumb-like process extending over ventral margin of juxta..... 24

24a. one of two cornuti of vesica borne upon a long slender arm extending from the apex of the aedoeagus
.....(p.28) genialis Grt.

24b. neither of the cornuti borne upon an arm..... 25

25a. inferior spine mass of cucullus quite broad dorso-ventrally; uncus quite stout, bulbous in the middle region, tapering to a narrow apex; apical scobinated area of aedoeagus well developed but not extensive; composed of moderately fine cuticular spicules; meso-ventral area of juxta with a prominent lobe raised above the general surface of the sclerite.....(p.30) aurantícolor b. sora Sm.

b. inferior spine mass moderately narrow dorso-ventrally; uncus slender, somewhat bulbous subterminally; apical scobinated area of aedoeagus very extensive and composed of coarse cuticular spicules. .....(p.31) grotei B. & McD.

26a. both cornuti borne in the middle region of the vesica.....(p.29) aurantícolor Grt.

b. one of the two cornuti borne in the middle region and one subbasally on the vesica..... .....(p.30) cinefacta a albertae Strand

27a. comb-like cornutus borne at the apex of a short, sclerotized arm extending from the aedoeagus onto the vesica; harpe long..... 28

b. vesica without comb-like cornutus; harpe very short 30

28a. sacculus with thorn-like projection at base of median rod..... 29

b. sacculus without thorn-like projection at base of median rod.....(p.33) impulsa Gn.

29a. a second sclerotized arm with a short spine at its apex extending from the aedoeagus onto the vesica. .....(p.46) ampliata McD.

b. second arm extending onto the vesica without apical spine.....(p.45) indocilis Wlk.

30a. uncus moderately broad basally but very slender for most of its length.....(p.40) plutonia Grt.

b. uncus stout and diamond-tipped.....(p.41) vultuosa Grt.

IX. CONCLUSIONS

The species of the genus Septis, on the basis of the structure of their external male genitalia, fall into a number of well defined groups.

The male genitalia of Septis nigrior Sm., verbascoides Gn., and vulgaris G. & R. are very similar in structure, and would indicate a close relationship among these moths.

Septis lignicolora Gn. and its races; antennata a purpurissata B. & McD., auranticolor Grt. and its races; cinefacta a albertae Strand, and commoda Wlk. together with its race alberta Sm. form another group, the genitalia of whose component species are very similar.

The genitalia of grotei B. & McD., inordinata Morr. and its races, and cinefacta Grt. are somewhat similar to those of the moths constituting the lignicolora group. On the basis of genitalia however, these moths are not so closely related either to each other or to those of the lignicolora group as are those moths which I consider constitute the group.

Septis arctica Frr., and castanea Grt., on the basis of the structure of the external male genitalia, are evidently very closely related.

The genitalia of Septis plutonia Grt. and of vultuosa Grt., although readily distinguishable, are indicative of a close relationship between these two species.

Septis impulsa Gn., indocilis Wlk, and its forms and races, and ampliata McD. form another well defined group.

The above mentioned groups would appear to be entirely comparable to the rather restricted genera recognized by McDunnough in his 1928 revision of the Phalaenines. As in the case with Phalaeninae, further study of other taxonomic characters would probably substantiate the groups indicated by the male genitalia. Whether these more or less restricted groups are considered worthy of generic rank or merely of subgeneric rank, however, depends of course on the leanings of the individual worker.

All of the species of the Septis studied, with the exception of arctica Frr. and castanea Grt., may be distinguished by examination of the male genitalia. In many cases races could also be distinguished by the examination of these organs.

Because of the often considerable differences between the external genitalia of the races of a single species it would appear that a revision of this group of moths would be very desirable. On the basis of the present study, a number of races would appear deserving of specific rank. Among those races that vary to a greater or lesser degree from the typical one in the structure of their genitalia may be cited Septis lignicolora b atriclava B. & McD., auranticolor a barnesi Sm., auranticolor b sora Sm., and cinefacta a albertae. The genitalia of the last mentioned race are strikingly dissimilar from those of the typical cinefacta Grt.,

and the former insect certainly would not appear to be a race of the latter. A much more extensive series of male genitalia as well as of other characters of the insect must be studied before satisfactory conclusions may be drawn as to the status of these so-called races. Some of the characters which appear to be discontinuously variable in the rather limited series of moths examined, may, on further study, actually be found to be continuously variable, and thus, according to the presently accepted morphological definition worthy of only subspecific rank.

X. SUMMARY

In this study of the external male genitalia of the members of the genus Septis, the specimens used belong to the Canadian National Collection of insects. Of the fifty-six species and "infraspecies" of Septis now attributed to North America, the male genitalia of forty-four have been described. Twenty-six of these have been figured.

No comprehensive study of the genital organs of this group has previously been made. Toward the end of the last century, John B. Smith figured, in a revision of the group, a small portion of the organs of some dozen species.

In the present paper the morphology of the external male genitalia of the Lepidoptera, with particular reference to the genus Septis, is discussed.

The genitalia of the moths studied were dissected out and mounted in clarite. Drawings were made with the aid of a microscope slide projector.

Descriptions of and a key to the genitalia of the species and "infraspecies" studied are presented. With the exception of Septis arctica Frr. and Septis castanea Grt., all of the species studied could be differentiated on the basis of the structure of the male genitalia.

A revision of the genus Septis would appear to be very desirable. On the basis of the structure of the male genitalia, the species fall into rather well-defined groups which would appear to be equivalent to the present accepted genera of the Phalaenines. Moreover, in the genus, a number of races differ considerably from the typical form in the structure of their male genitalia. With further study these presently recognized races may be found deserving of specific rank.

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